

# Blast Syndrome

**Blast syndrome** is a syndrome (set of symptoms) arising from an explosion. This is an injury caused by the impact of a pressure/shock wave on the human body. The essence of an explosion is a *violent transformation of energy* (chemical, nuclear, etc.), which leads to a rapid increase in the temperature and pressure of the gas at the place of the explosion and to the expansion of the explosion products into the surroundings.

## Injury

The energy of the shock wave is released as it propagates whenever it passes through an interface where the acoustic impedance changes. Typically, therefore, at the *soft tissue - air* or *soft tissue - bone* interface. The extent of injury depends on the intensity and duration of exposure.

### Primary injury

- Caused by a locally acting pressure wave (gas, liquid, solid).
- They occur most often when a person is close to the source of the explosion (land mine).
- There is primarily an injury to the organs that contain air (first the injured middle ear manifests itself, then the lungs (contusion, bleeding, damage to the alveoli), the intestine (here the injury could only manifest itself after several hours), ...)
- The brain is also traumatized.
- Primary injuries are characterized by the absence of external injuries, so the severity and extent of injuries are often unrecognized or underestimated.

### Secondary

- The remains of objects that are thrown into the surroundings by the explosion play their role here.
- This includes penetrating and perforating trauma with visible bleeding or bleeding into internal organs. The presence of shrapnel significantly complicates treatment.

### Tertiary

- This is an injury up to the extent of amputation, caused by a strong impact of air or the impact of the human body against an obstacle. Often accompanied by penetrating injuries.

### Indirect

- Arising in a different context (e.g. building collapse, being trampled by a crowd), burns, crush syndrome.

## Dependence on the distance from the epicenter

1. **epicenter** - devastating, loss, fatal wounds
2. **primary zone** - pressure wave acting on the middle ear or lungs
  - in **open space** the shock wave spreads *spherically*, *reflects* from the ground and from standing objects; *overpressure* is followed by a wave of *underpressure* and a rapid *normalization* of pressure ratios
  - in a **closed space** the pressure wave is *reflected* and the overpressure lasts longer, the proportion of primary injuries increases; on the contrary, due to obstacles (e.g. bus seats), the share of shrapnel injuries decreases
  - **immersion blast syndrome** (propagation of a pressure wave in a liquid)
    - mainly abdominal contusion with ring ruptures, eyeball contusion
  - **solid blast syndrome** (propagation of a pressure wave in a solid environment)
    - multiple fractures of limbs (for those who were standing at the time of the explosion), pelvis and spine (for those who were sitting)



## Injury to individual organs

1. **ear** - perforation of the eardrum with possible hearing damage
2. **lung** - rupture of the alveolocapillary membrane accompanied by bleeding and air embolization into the arteries of the brain and heart; neither emphysema nor pneumothorax is an exceptional finding
3. **heart** - the injury may subsequently be accompanied by heart rhythm disorders
4. **GIT** - contusion to perforation of the intestinal wall
5. **limbs** - amputation of peripheral parts of limbs
6. **muscle** - crushing develops crush syndrome and subsequent rhabdomyolysis

## Treatment of those injured in the explosion

